University of Thessaly
Department of Physical Education and Sport Sciences

Title
Physical Activity, Sleep Apnea and Quality of Life

By

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Declaration by Author

This thesis is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text. I have clearly stated the contribution by others to jointly-authored works that I have included in my thesis.

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Contents

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Abstract

Obstructive sleep apnea is a medical condition characterized by nocturnal breathing cessation due to airway occlusion. Consequences and symptoms of the disease such as impaired quality of sleep can drastically impaired the quality of life of patients. The most commonly used treatment of OSA is positive airway pressure (PAP), however compliance is low and a range of 46 to 83% of patients do not adhere. A treatment alternative is physical activity (PA). It has been shown to improve sleep apnea condition. However, there are a limited number of studies examining the association of physical activity and quality of life in obstructive sleep apnea patients. The purpose of the present study was to investigate the relation between physical activity and quality of life in sleep apnea patients.

Questionnaires were used to assess the different variables of the study: The IPAQ was used to assess physical activity. Epworth Sleepiness Scale was used to assess daytime sleepiness and give an indication of the sleep apnea severity. Finally, the SF-12 was used to measure the health related quality of life. Seventy-eight sleep apnea patients completed the questionnaires. Results showed a positive relationship between low intensity physical activity and quality of life. A relationship has been found between quality of life and sleep apnea severity. Finally, low intensity physical activity predicted quality of life in sleep apnea patients.

The findings of this thesis support that physical activity could be an adequate treatment option, improving the quality of life and the sleep apnea symptoms in sleep apnea patients.

Keywords: sleep apnea, physical activity, quality of life, obstructive sleep apnea.

Introduction

Sleep apnea is a medical condition which causes repetitive episodes of nocturnal breathing cessation (during from a few seconds to a few minutes) (Spicuzza et al., 2015) and can be Obstructive Sleep Apnea (OSA), and be caused by airway occlusion. Finally, sleep apnea can be central (CSA), and lead to lack of breathing control. This study focus on obstructive sleep apnea which is the most common form. Both OSA and CSA lead to negative consequences at different levels: symptoms such as daytime sleepiness, loud snoring and restless sleep are characteristics of the disorder (Motamedi et Al., 2009). Other negative manifestations accompanying OSA can be depression, irritability, mood disorders, impaired cognition, difficulty of concentration or short-term memory loss. It affects the personal life at a familial, professional and social level (Coman, 2016).

Prevalence

Based on a systematic review including 24 studies, the overall population prevalence of sleep apnea ranges from 9 percent to 38 percent and is higher in men. Based on 11 epidemiological studies published between 1993 and 2013, the prevalence of OSA for men is estimated to be from 9 to 37 percent (Franklin & Lindberg, 2015). For women, the prevalence is estimated to be from 4 to 40 percent. However, another study estimates the prevalence for OSA being from 3 to 7 percent of the population (Punjabi, 2008). Some factors make people more at risk: the age, being a male, obesity, family history, menopause, craniofacial abnormalities, and certain health behaviors such as cigarette smoking and alcohol use.

Sleep Apnea and Health related Quality of Life

Health related quality of life regroups aspects of a patient's life such as his emotional and mental health, his physical condition and energy (Gandek et al., 1998) It can be defined as the patient's perception of their position in life, related to their particular disease and treatment (Sosnowski et al., 2017). The state of health has an influence on the everyday functioning of individuals.

Symptoms, consequences and treatments of diseases have their consequences on someone's life and functioning (Schipper et al., 1990). The World Health Organization defines HRQoL as something that has to be evaluate in the context of the culture and value systems of individuals., taking goals, expectations, standards and concerns into account." (Sosnowski et al., 2017).

HRQoL has an objective component, including the direct physical symptoms of a particular disease, as well as a subjective component, including the patient's personal opinions, emotions and feelings related to their state. Different aspects: such as general health, physical functioning, body pain, mental health and vitality, social functioning, emotional and mental health are components of the HRQoL. (Huo et al., 2018). All those aspects can be measured by both the SF-36 and the SF-12.

OSA patients' state of health has different repercussions on the everyday functioning. Obstructive sleep apnea impairs QoL at different level. First of all, the patient's quality of life is impaired by daytime symptoms (Lacasse et al., 2002): One of OSA's main symptom and consequence is daytime sleepiness. Patients have an unrefreshing sleep, they can have difficulty staying awake during daytime and lack control over their ability to stay awake. In addition to having episodes of suddenly falling asleep, they might have consequences such as lack of concentration, attention and memory deficit. (Naegele et al, 1995). Sleep apnea can lead to physical symptoms such as congested nose, dry mouth or sorethroath or headaches upon wakening, directly impairing health related quality of life (Clarenbach et al., 2008; Mannarino et al, 2012). Patients are limited in their everyday life functioning as they might not have the control on the activities that can do; they might have difficulty doing activities such as reading or driving. They can have the feeling of having to fight a urge to sleep while doing an activity. They might need to take naps during daytime, preventing them from doing what they want. Another way quality of life of OSA patients is affected is by the disturbed quality of sleep (Colt et al., 1991): snoring is a common symptom and consequence. Patients tent to often wake up during the night and suffer from restless sleep. Sometimes patients wake up during the night with a sensation of choking (Mannarino et al., 2012). Due to the impair quality of sleep, OSA patients tends to wake up early in the morning, limiting their duration of sleep. It is common for them to wake up with a dry mouth. Sleep apnea patients are also affected at an emotional level: consequences such as depression and anxiety are common. OSA patients might have concerns about their health and weight. (Wittels et al., 1990) Finally, quality of life of OSA patients is impaired at a social level. Patients might be worried of their snoring impairing their partner and friends' sleep. Due to their lack of energy, sleep apnea patients might participate in less social activities (Moore et al., 2001).

Consequences of lack of quality sleep

Sleep apnea prevents from quality sleep. Sleep disruption leads to both short- and long-term consequences: increased stress responsivity, emotional distress, mood disorders, impact on cognition and memory, and performance deficits. Somatic problems, as weekly headache or abdominal pain are others possible repercussions of sleep deprivation (Luntamo et Al.,2012). In the long run, sleep disruption consequences include hypertension, dyslipidemia, weight-related issues, metabolic syndrome, poor appetite regulation, poor functioning of immune, hormonal and cardiovascular systems (Medic, 2017).

Cardiovascular consequences

Obstructive sleep apnea is seen in 37 percent of 450 and 11 percent of 81 patients with heart failure resulting from systolic dysfunction (Somers et al., 2008). Also, OSA is associated with a significant cardiovascular morbidity and mortality. Cardiovascular consequences, such as hypertension, resistant systemic hypertension, chronic heart failure, arrhythmia, myocardial infarction and stroke can be caused by sleep apnea. Specifically, OSA is characterized by intermittent hypo xemia and CO_2 retention during sleep, with oxygen saturation dropping up to 60 percent. These factors cause cardiac and vascular diseases.

Depression

Depression is a mood disorder, it leads to different symptoms such as experience of persistent feelings of sadness, loss of interest in activities and hopelessness (American Psychiatric Association,2013). Depression in OSA patients is quite prevalent (Ejaz et al., 2011): specifically, the prevalence of depression is higher in patients with OSA as compared to the general population according to a study with 182 patients which found that 25 percent of participants (47 patients) were suffering from depression (Shoib, 2017). Studies favor a mutual relationship between OSA and depression. The relationship remains unclear, as different mechanisms could explain how OSA can worsen depression and vice versa (Ejaz et al., 2011).

Anxiety

Generalized anxiety disorder is characterized by different symptoms: excessive anxiety and worry about various topics, difficulty to control the anxiety, impaired concentration, irritability, tiredness. A research study that examined the association between OSA and other comorbid disorders in Veterans Health Administration beneficiaries (Sharafkhaneh et al., 2005) found that 16,7 percent of the people suffering from sleep apnea were also suffering from anxiety. Also, 11,9 percent were suffering from posttraumatic stress disorder, 21,8 percent were suffering from depression (Sharafkhaneh et al., 2005). This is a significantly greater prevalence in comparison to patients not diagnosed with sleep apnea (Sharafkhaneh et al., 2005). Also, disruption and discontinuity of sleep has a bigger role than the duration of sleep deprivation for increased stress responsivity (Tiemeier et Al., 2002)

Treatment

The most common treatment used for OSA is positive airway pressure (PAP), which is typically recommended for mild, moderate, and severe OSA (Epstein et al., 2009). PAP can be delivered in continuous (CPAP), bilevel (BPAP), or autotitrating (APAP) modes (Epstein et al., 2009). BPAP machines differ from CPAP: the first one have two pressure settings: one for inhalation and one for exhalation.

Treatment consequences

A range from 46 to 83% of patients with obstructive sleep apnea do not adhere to PAP treatment. Nasal continuous airway pressure can have side effects as getting allergy to the face, air leaks, abrasions of the ridge of the nose (Pépin et al.,1995). PAP has been shown to have negative side effects at different levels (Gay and al., 2006). The material and design of the mask itself can cause allergy, claustrophobia, mask leak, skin abrasion or conjunctivitis eyes. PAP can also have pressure-related side effects, such as rhinitis, sinusitis, headache or pressure intolerance (Gay and al., 2006). The equipment can be perceived as noisy, cumbersome and invading the intimacy of the patient, moreover it needs to be taking care of and cleaned (Gay and al., 2006)..

Sleep apnea and physical activity

People with untreated obstructive sleep apnea may engage in less physical activity. Fatigue and daytime sleepiness that results from sleep apnea might influence on the physical activity participation (Jean et al., 2017). Specifically, OSA impair exercise capacity and increase cardiovascular risks by several mechanisms (Beitler et al., 2014): a difference in the lactate concentration and a delay in the elimination of lactate have been observed in OSA subjects in comparison to age and BMI-controlled group. Patients with OSA have been shown to have abnormal cardiovascular responses during exercise or recovery. Increasing of the diastolic blood pressure, decrease of the stroke volume, attenuation of the heart rate during peak exercise and recovery or global ventricular dysfunction have been shown.

Sleep apnea and sedentariness

The level of physical activity of OSA patients is low. A meta-analysis (Mendelson et al., 2018) explored on one side the objective physical activity levels of patients with OSA and on the other side, the effects of exercise training on OSA severity, body mass index, sleepiness and cardiovascular fitness. The meta-analysis showed that OSA patients were not physically active. The second part of the meta-analysis found a significant decrease in apnea-hypopnea index following exercise training (mean decrease of 8.9 events/h; 95% CI: −13.4 to −4.3; $p < 0.01$). Also, a reduction in subjective sleepiness, an increase in VO2peak and no change in BMI were observed.

Spicuzza (2015) reported that weight loss improves symptoms and morbidity in all OSA patients and claimed that a multidisciplinary approach is necessary for an accurate management of the disease.

Obesity is associated with sleep apnea (Schwartz et al., 2008). Adiposity around the pharynx and torso might narrow the upper airway and increase the chance of upper airway collapsibility. Also, obesity is associated with a reduction in lung volumes. A reduction in weight is an effective strategy for treating sleep apnea in obese patients. Physical activity is an effective treatment that can be used in the aim of reducing the weight of obese people. It can solve the anatomic alterations of obesity people and reduce sleep apnea symptoms. However, physical activity may also be beneficial without weight loss consequences.

Physical Activity as A Treatment of OSA

Positive Airway Pressure have been shown to have negative side effects and can increase comorbidity. A range of 46 to 83 percent of patients do not comply to this treatment, the symptoms of OSA could be difficult to manage by those people (Kenneth et al., 2016). Other treatments for OSA and its symptoms that are less invasive are essential: exercise is an option to improve OSA indices, it would constitute a low-cost and easy-to-use treatment modality (de Andrade et al., 2016).

Exercise training has moderate treatment effects on the reduction of apnea-hypopnea index (Kline, 2011) Results suggested that exercise may be beneficial for the management of OSA beyond simply facilitating weight loss. The study included forty-three sedentary and overweight adults with at least moderate-severity untreated OSA, the exercise treatment consisted in 150 minutes of exercise per week for 12 weeks. Exercise consisted in moderate-intensity aerobic activity once a week followed by resistance training twice a week. The control group met twice weekly for 12 weeks and perform low-intensity exercises designed to increase whole-body flexibility.

Sengul et al. (2009) in their RCT found that breathing exercise and other types of exercise have a beneficial effect on apnea-hypopnea index, quality of sleep, exercise capacity and health related quality of life in patients with mild to moderate OSA~~.~~ The exercise group followed a program consisting in 1.5 hours of exercise, three days a week for 12 weeks whereas the control group did not receive any treatment.

A meta-analysis (Iftikhar and al.,2014), using 5 studies with 129 participants in total, showed a statistically significant effect of exercise in reducing the severity of sleep apnea in patients with OSA with minimal changes in body weight. The potential value of exercise was due to its effect on cardiorespiratory fitness, daytime sleepiness, and sleep efficiency.

Another meta-analysis (Aiello, 2016) using 8 articles with 182 participants also conclude that exercise has an effect on the severity of apnea. Exercise induces a decrease on the apnea/hypopnea index and decreases sleepiness during day time.

Physical activity effects on Quality of Life in OSA patients

Conn et al. (2009) have shown with a meta-analysis that interventions to increase physical activity increase quality of life: the mean of quality of life effect size was .11 for two groups comparison and .27 for pre-post comparison. The study included Eighty-fives samples with 7 291 subjects.

Physical activity increases the quality of life of OSA patients (P<0.01) (Ueano et al., 2009). The study included twenty-five patients with heart failure with obstructive, central or no sleep apnea. The interventions consisted of four months of no-training followed by four months of an exercise training program.

The effects of Physical activity on Depression in OSA patients

Physical exercise is associated with reduction of depression symptoms. Specifically, a systematic review and meta-analysis that included 455 patients across 11 trials found that aerobic exercise is an effective antidepressant intervention that has a large overall effect (Morres et al., 2018).

Compared to control group, physical exercise showed higher effects on depression symptoms in OSA patients (Kline et al., 2012). The clinical trial included forty-three overweight/obese and sedentary adults (18-55 years old) with untreated OSA.

Method

Participants

Recruitment was conducted through the Sleep Apnea Project of the University of Thessaly. A total of 51 participants were patients of the University of Thessaly Hospital (Larissa, Greece). A total of 27 patients were referred by a nurse from the André Vésale Hospital (Charleroi, Belgium). A written consent form was acquired before participation by all patients.

Participants were 78 adults with obstructive sleep apnea (51 males and 27 females), with a mean age of 48.45 (SD= 10.63) years. Participants had to be a minimum of 17 years old to be included in this study.

Procedure

Questionnaires were used to assess the variables of the present study. The French version of the SF-12 Survey, a shorter version of the SF-36, was used to measure functional health and well-being from the patient's point of view (Ware et al., 1996). The Epworth Sleepiness Scale was used to assess daytime sleepiness (Johns, 1991). The IPAQ (International Physical Activity Questionnaire) was used to measure physical activity (Craig et al., 2003).

Results

With respect to Quality of Life and METS variables, correlations showed a moderate significant relationship between quality of Life and low intensity physical activity (METs low) (.23, p=.046), no significant relationship have been found with the variables METS moderate (.20, p=.087) and METS high (.15, p=.743). Mets low predicted quality of life.

A significant relationship has been shown between quality of life and Ipaq item 1 (.24, p=0.035) and Ipaq item 5 (.29, p=.014). Item 1 refers to high intensity physical activity (self-reported days of high intensity physical activity), item 5 refers to the number of days someone walked for at least 10 minutes.

Finally, a significant relationship has been found between quality of life and METS total (.28, p=.015). Mets total refers to an estimated metabolic equivalents of total intensity physical activity, it includes low, moderate and high intensity.

A significant relationship has been found between Quality of Life and Epworth, this variable showed a moderate negative correlation (-.41, p=.000).

With respect to Epworth and IPAQ, a significant relationship has been found with IPAQ_Item 7 (.27, p=.021). Ipaq Item 7 refers to sedentariness (time spent seated). No significant correlations have been found between the variables Epworth and IPAQ total (-.11, p=.285). Results can be found in Table 1 and Table 2.

Table 1. Descriptive Statistics for studied variables

	Minimum	Maximum	Mean	Standard Deviation
Age	17	77	48,45	10,633
IPAQ-1	0	6	,58	1,274
IPAQ-2	0	240	47,09	67,623
IPAQ-3	0	7	1,53	2,106
IPAQ-4	0	180	61,03	50,380
IPAQ-5	0	7	4,30	2,408
IPAQ-6	0	480	47,92	65,680
IPAQ-7	2	720	87,60	148,866
METs IPAQ Low	,00	1680,00	208,1081	278,54527
METs IPAQ Moderate	,00	980,00	91,4359	170,27515
METs IPAQ High	,00	1200,00	48,7564	164,09802
METs IPAQ Total	,00	2600,00	355,8784	421,78187
Sleepiness	,00	18,00	6,7564	4,42597
QoLife Physical	6,00	25,00	19,1667	4,38835
QoLife Mental	10,00	29,00	21,1026	4,79066
QoLife Total	18,00	54,00	40,2692	8,13151

QoLife : Quality of Life; IPAQ : International Physical Activity Questionnaire; METs: Metabolic Equivalents

Table 2. Correlation coefficients for studied variables

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	IPAQ-1														
2	IPAQ-2	.48**													
3	IPAQ-3	.32**	.11												
4	IPAQ-4	.10	.31	.08											
5	IPAQ-5	.10	.07	.22	.18										
6	IPAQ-6	-.00	.47**	-.13	.24	.04									
7	IPAQ-7	.16	-.35	.21	-.03	-.19	-.13								
8	METs Low	-.00	.36*	-.09	.23	.35**	.86**	-.19							
9	METs Moderate	.31**	.43*	.66**	.64**	.23*	-.02	.20	.05						
10	METs High	.68**	.84**	.30**	.26	.07	.11	.07	.08	.51**					
11	METs Total	.39**	.70**	.32**	.50**	.35**	.60**	-.02	.71**	.65**	.66**				
12	Sleepiness	-.08	-.08	.06	-.15	-.19	-.02	.27*	-.11	-.08	-.04	-.13			
13	QoLife Physical	.28*	.29	.19	.21	.16	.08	.10	.14	.19	.17	.23	-.29*		
14	QoLife Mental	.15	.14	.14	-.03	.34**	.17	-.08	.26*	.16	.10	.16	-43**	.57**	
15	QoLife Total	.24*	.23	.19	.09	.29*	.15	.01	.23*	.20	.15	.28*	-.41*	.88**	.90**

QoLife : Quality of Life; IPAQ: International Physical Activity Questionnaire; METs: Metabolic Equivalents;
*: Statistically Significant <.05 **: Statistically Significant <.001

Table 3. Regression analysis for quality of life

	Beta	t	p	F	R^2 change
Significant predictor				4.12*	.23
Mets Low (Light Physical Activity)	.23	2.03	.046		
Excluded Predictors					
Mets High (Vigorous Physical Activity)	.12	1.08	.28		
Mets Moderate (Moderate Physical Activity)	.17	1.45	.15		

*: Statistically Significant at .05

Discussion

Physical activity and quality of life in OSA patients

The results of this study found that low intensity physical activity was significantly correlated and predicted quality of life. Although the numbers of days of high intensity physical activity was associated with an increase in quality of life, METs high was not correlated with quality of life. This suggests that low intensity physical activity could be an adequate treatment to increase quality of life of OSA patients.

Low physical activity is an easier treatment option in comparison to moderate or high intensity physical activity. Walking or doing activities such as house cleaning or gardening are some example of low intensity physical activity. This suggests that simply a change of lifestyle could be effective in improving the quality of life of sleep apnea patients. Moreover, those activities and this type of physical activity does not necessitate a gym.

In term of motivation, it could be assumed that it is easier to motivate sleep apnea patients to do low intensity physical activity in comparison to moderate or high intensity. A study from Perri et al. (2002) found that increasing exercise intensity may lower adherence while increasing exercise frequency did not show any decline in adherence. The same study found that a high intensity exercise was correlate to higher exercise-reported injuries. Low intensity physical activity might be a good treatment option for sleep apnea patients as there is less chances to get injured. (Perri et al., 2002)

In the literature, physical activity has been found to be associated with quality of life in various populations: in a 2007 meta-analysis including 55 studies, Bize et al.(2007) showed a consistently positive association between physical activity and health related quality of life in the general population. A study by Rejeski et al. (2001) analysed studies on physical activity and quality of life among older adults in various settings: physical activity and exercise were found to be related to better quality of life in retirees men (Peppers, 1976), in adults with physical disabilities (Jette et al., 1999), in adults with chronic obstructive pulmonary disease (Emery et al.,1998) in patients with myocardial infarction and other heart diseases (Tyni-Lenné et al., 1998). Finally, physical activity have been found to be related with improved quality of life in older adults with minor to major depression (Singh et al., 1997).

Specifically, in OSA patients, studies have found that physical activity and exercise improves quality of life. Studies addressed physical activity in the aspect of exercise such as aerobic and resistance training or physical activity in a general way. These effects of exercise on quality of life favored CPAP. (Ackel-D’Elia et al., 2012).. Other studies assessed exercise in association with a weight-reduction diet (Barnes et al., 2009).

Exercise training induce small to significant improvements of the quality of life components in OSA patients. That is what has been found in a study by Kline et al. (2012) on 43 participants using the SF-36 questionnaire. The exercise training consisted in moderate-intensity aerobic and resistance training, six days a week for 12 weeks. The control group was doing stretching. Significant improvements have been found in physical functioning, vitality and mental health. Small to moderate sized improvements have been found in all aspects of quality of life except for bodily pain, social functioning and role limitations due to emotional health.

Regular physical activity has been found to be a better predictor than sleep apnea severity in predicting perceptions of energy and fatigue; regular physical activity is significantly correlated with higher SF-36 vitality. (Hong et al., 2003). The results remain significant after controlling for BMI.

A study by Barnes et al. (2009) on 21 OSA patients following a weight reduction diet and an exercise program found a significant effect on quality of life, however no effects have been found for the sleep-specific quality of life questionnaire. (Functional Outcomes of Sleep Questionnaire). The intervention consisted in 16 weeks of resistance, aerobic training (80% VO2PEAK) and a low-energy meal diet.

In comparison to a CPAP treatment only, a 2-month exercise training (running and walking, 85 percent of the anaerobic threshold) combined with CPAP treatment has been found to have a significant and better impact on quality of life (physical functioning and general health perception) as well as on subjective daytime sleepiness and mood states (Ackel-D'Elia et al., 2012).

Sleep Apnea and Quality of Life

In accordance with the literature, a significant moderate relationship has been found between quality of life and sleep apnea severity. Quality of life can be defined as the patient's perception of their position in life, related to their particular disease and its treatment. (Sosnowski et al., 2017).

The results of this thesis aligned with the current literature: poor quality of life has been found to be one of the most common complaint among obstructive sleep apnea patients. Impaired daytime functioning, excessive daytime sleepiness, fatigue and other consequences in cognitive function, and mood are characteristics of OSA (Kline et al., 2012). Subjective distress and poor quality of life in general are frequently reported by OSA patients, even after adjusting for body mass index (BMI), gender, age and comorbidity (Hong et al., 2003).

Mediators and moderators

The relation between physical activity and quality of life can be explained by different variables: studies have looked at the mediators and moderators between physical activity and quality of life (Joseph et al., 2014; Rejeski et al., 2001). In general population and in sleep apnea patients, physical activity can increase quality of life by different mechanisms including enjoyment of an activity, self-efficacy feeling, self-esteem enhancement and increase in energy. Some of the variables might play a bigger role for the sleep apnea patients; increase in energy might be particularly beneficial for them as their condition implies that they suffer from low energy and fatigue.

One explanation that has been found in the literature is that physical activity is an enjoyable activity in itself and that the repeated enjoyment that someone gets from the activity enhance his quality of life. Fox et al. (2000) has found that manipulating social interaction in an exercise activity such as aerobic dance impacts on the enjoyment perceived. The authors suggest that the enjoyment created by a socially enhanced environment could improve quality of life.

Rejeski et al. (2001) suggests that the feeling of self-efficacy, the individual belief in its capacity can mediate the relation between physical activity and quality of life. Self-satisfaction and the feeling of being proud of yourself can also be a mediator.

Physical activity has been shown to enhance self-esteem, which can also be a mediator. Self-esteem is a predictor of quality of life. A study by Elavsky et al. (2009) has found that both self-esteem and positive feeling state induced by physical activity were correlated to long-term quality of life in older adults.

Another potential mediator is energy. Physical exercise has been show to increase feeling of energy and decrease feeling of fatigue. (Rejeski et al., 2001)

The value someone placed on physical activity can be a moderator. (Rejeski et al., 2001).

Those mediators seem to be comparable with the self-determination theory which suggests that the satisfactions of the three psychological needs of autonomy, relatedness and competence leads to autonomous motivation to be physically active.

Physical Activity and Epworth

The results of this thesis shows that sleep apnea severity (measured by the Epworth) was correlated to sedentariness and the amount of time in a day a patient spent seated.

Impaired day-time functioning is one of the main complain of sleep apnea patients. One of the major symptom of OSA is day-time sleepiness; sleep apnea patients feel sleepy during day-time; they are at risks of falling asleep during various activities (Kline et al., 2012). The likelihood of falling asleep is assess by the Epworth Sleepiness Scale: patients have to report if they fall asleep in eight different sedentary activities. Various studies have demonstrated a positive impact of physical activity on sleepiness: Hong et al. (2003) demonstrated that physical activity was significantly correlated with daytime sleepiness in sleep apnea patients.

The literature has demonstrated that physical activity was associate with reduction of day-time sleepiness in sleep apnea patients and in other medical population.

A study by Kline et al. (2012) including forty-three sedentary overweight OSA patients demonstrated that exercise training was positively correlated to improvement in day-time functioning, including day-time sleepiness. Exercise training may be helpful for improving aspects of day-time functioning of adults with OSA: exercise training produces a moderate size reduction in day-time sleepiness measured on both the ESS and FOSQ-10. Participants of the study were randomized into two groups: one following a 12-weeks plan of moderate-intensity aerobic and resistance training, the other following a low-intensity stretching control treatment.

A study on insomnia patients compared aerobic exercise and sleep hygiene, to sleep hygiene only. The combination of aerobic exercise and sleep hygiene was associate with a reduction in daytime sleepiness. (Reid K.J. et al., 2010)

A meta-analysis on 12 population-based studies has found that physical activity was associated with a 40 percent reduced risk of experiencing feeling of low energy and fatigue. (Puetz, 2006)

The duration and frequency of exercise might have an impact on fatigue perception. Andreasen et al. (2011) have studied the effect of exercise therapy on fatigue in patients with multiple sclerosis (MS). The study demonstrated that longer and low-frequency protocols might be more efficient to reduce fatigue in comparison to high-frequency and short-duration protocols for MS patients. The authors suggest that a social component could influence the fatigue's level of perception. Group exercise and contacts with other participants might play a role.

A randomized controlled trial from Puet et al. (2008) reported that low-intensity exercise had a positive effect on the level of perceived fatigue in sedentary young adults with persistent fatigue. Moderate exercise has been found to have a positive impact on health outcome such as reduction of depression but did not have an impact on fatigue perception. These authors suggested that moderate exercise might be too demanding for a population reporting persistent fatigue. The same study assessed the perception of energy and found that both low and moderate intensity has a positive impact. The two different patterns for the variables of fatigue and energy perception remained unclear.

Self-determination Theory

The literature review and the results of this study suggests that physical activity is an effective treatment to improve the condition of sleep apnea patients and improve their quality of life. Motivating sleep apnea patients to be physically active might be an important issue. The self-determination theory is a theory of motivation that could be effective to motivate sleep apnea patients to be active.

The SDT is a theory of human motivation and personality, according to the self-determination theory, the continuum of motivation is described by lack of motivation (amotivation), then by extrinsic motives and is finalized by intrinsic motives. The extrinsic motives include external motivation which refers to behavior for rewards and awards and by introjected motivation which refers to a behavior that is implemented by the person to avoid feeling of guilt. As far as the intrinsic motive is concern, this includes internal motivation which refers to a behavior that is implemented for joy and pleasure, and the identified motivation which refers to a behavior that is implement due to personal values and reasons. In SDT, also, both external and introjected motives comprise the so called “controlled motivation”, whereas both internal and identified motives comprise the so called “autonomous motivation”.

The self-determination theory also includes three dendrites which are the three basic psychological needs of competence, autonomy and relatedness. Competence refers to the need of feeling effective and developing, autonomy refers to the need of having the feeling of selfdirection and self-endorsement in action, relatedness refers to the need of feeling meaningfully connected to others.

The self-determination theory also reports that when these three psychological needs are satisfied, they catalyze the facilitation of autonomous motivation (the internal and identified motives). As far as the satisfaction of the three psychological needs is concern, SDT suggests the synergetic satisfaction of all three psychological needs.

The SDT have a great reach, encompass concepts that have personal meaning, leads to empirical methodologies and use principles that can be apply on different life context: parenting, heath care, education, work, sport and psychotherapy for example.

The theory postulates that all individuals naturally want to be active, motivated, curious and willing to succeed, as success is gratifying in itself. The theory also recognizes that some individuals can be passive and unmotivated. Those difference in motivation are explained by the different type of motivation: autonomous and controlled. The type of motivation that an individual has results from the interaction between the inherent active nature of individuals and the environment, which can be supporting or thwarting.

Physical Activity and SDT

Various studies demonstrated that the self-determination theory is efficient in a physical activity and exercise context. In a meta-analysis including 184 independent data set, Johan et al. (2012) demonstrated an existent relation between psychological need satisfaction, autonomous motivation and beneficial health outcomes. The meta-analysis included various study in health care and health promotion contexts. Specifically, a study by Silva et al. (2011) showed the links between psychological needs satisfaction, autonomous motivation and exercise adherence: satisfaction of competence, relatedness and autonomy is related to autonomous motivation and exercise adherence. A systematic review by Teixeira et al. (2012) showed a positive relation between autonomous forms of motivation and exercise; in most of the included studies, identified regulation was predicting initial/short term adoption and intrinsic motivation was predictive of long-term exercise adherence. Competence satisfaction positively predict exercise participation across a range of samples and settings.

A study by Edmunds et al. (2006) investigated the adherence of obese/overweight people on physical activity. Individuals who adhered more reported more self-efficacy to overcome barriers to exercise and demonstrated an increase in relatedness need satisfaction over time. The study also found that need satisfaction predicted self-determined regulation.

Sleep Apnea and SDT

The self-determination theory could also be beneficial to sleep apnea patients in other context that are not related to physical activity. The satisfaction of the three psychological needs in life can have an impact on sleep; a study by Campbell et al. (2015) including 215 adults found that the satisfaction of the three psychological needs of competence, relatedness and autonomy was positively related to two components of sleep: perceived sleep quantity and quality (Pittsburgh Quality Index) and was negatively related to day-time dysfunction, which was assessed with the Insomnia and Lassitude subscales as well as the Fatigue Severity scale and the General Vitality scale.

According to Campbell et al. (2015), the positive relation between psychological needs satisfaction and improved sleep could be related to two facts. First, people who satisfy their psychological needs are more likely to encounter positive daily experiences, second, to have positive thoughts when falling asleep.

Another finding of the study (Campbell et al., 2015) is that the psychological needs satisfaction are partial mediators of the relation between sleep quality and quantity and daytime dysfunction with financial strain and mindfulness. Mindfulness is positively related to sleep quality and quantity and negatively related to day-time dysfunction. This relation could be explained by the partial mediating effect of psychological needs satisfaction. As far as the financial strain is concerned, it seems that it is negatively related to sleep quality and quantity and day-time function. This infers that the relationship is maybe due to the threatening impact of financial strain on psychological needs.

SDT and quality of life

According to the SDT model, the patient's experience of autonomy, competence and relatedness is associated with better mental health (fewer depressive symptoms, anxiety and somatization), better health related outcomes, including more physical activity, as well as greater quality of life (Ryan et al., 2008). A study by Chen et al. (2018) found a positive relation between hemodialysis patient's perceptions of autonomy support and health related quality of life (physical and mental component) through basic psychological needs satisfaction. This infers that the autonomy support provided by physicians and nurses contributes to the improvement of the health-related quality of life of patients through basic need satisfaction. A study by Duda et al. (2014) comparing an SDT-grounded physical activity consultation with a standard provision exercise referral have found a difference in term of participant's psychological well-being outcomes. The study concluded that it could be due to the basic needs' satisfaction promoting environment.

Studies and meta-analysis have shown that the satisfaction of psychological needs is related to quality of life in different populations and contexts. Studies in school contexts, health behavior contexts, on adolescents, on people suffering from different diseases such as HIV or diabetes have investigated this relation and found that psychological needs satisfaction was positively related to quality of life improvement. (NG et al., 2012; Gillison et al., 2006; Shah et al., 2016; Standage et al., 2012)

Conclusion

The results of this study supports the existing literature review on physical activity and quality of life. In this Thesis we found that a relation exists between physical activity and quality of life and in sleep apnea patients. Specifically, low intensity physical activity predicted better quality of life. An association between sleep apnea severity and sedentariness has been found. Finally, the results showed a significant relation between quality of life and sleep apnea severity. These findings support the fact that low intensity of physical activity could be an effective option to improve quality of life of sleep apnea patients.

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